

# 14-year follow-up of patients who underwent either anatomic double-bundle or anatomic single-bundle anterior cruciate ligament reconstruction: A randomized controlled trial

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## INTRODUCTION:

Over the past two decades, surgical techniques have been developed to achieve anatomical ACL reconstruction using either the single-bundle (SB) or the double-bundle (DB) technique. Biomechanical studies have shown that DB reconstruction provides greater anterior and rotational stability than does the SB technique, whereas other biomechanical research has suggested that DB reconstruction might not provide appreciable additional benefits over the SB technique. Additionally, several clinical trials with short- and medium-term follow-ups have compared the functional outcomes of the SB and DB techniques, achieving conflicting results. Some studies highlighted that DB ACL reconstruction might offer superior rotational stability and lower re-injury rates. In contrast, randomized clinical trials and meta-analyses have reported no significant differences in knee laxity and objective outcomes between the two techniques.

ACL injury increases the risk of developing osteoarthritis (OA) nearly five-fold, and radiographic evidence of OA is seen in 50–90% of all ACL injuries at 10–15 years of follow-up. Some authors propose that reconstruction may delay its onset and help reduce secondary injuries to the menisci and cartilage. It has been shown that the DB technique is as ineffective as the SB technique in preventing the progression of OA for up to 10 years after ACL reconstruction.

Based on previous findings, the aim of this long term prospective randomized study was to compare the clinical and radiographical outcomes of the anatomic DB and anatomic SB techniques at least 14 years after ACL reconstruction. The primary hypothesis posited that, at the 14-year follow-up, the anatomic DB technique would yield fewer positive pivot-shift test results than would the anatomic SB technique. Furthermore, an additional hypothesis was that there would be fewer radiographic OA changes in the DB group.

## METHODS:

One hundred and five patients (33 women, 72 men; median age, 27 years [range, 18–52 years]) were randomized and underwent ACL reconstruction (DB group:  $n = 53$ ; SB group:  $n = 52$ ). All ACL reconstruction procedures were performed anatomically using the anteromedial portal for femoral tunnel drilling. One blinded observer examined the patients preoperatively and at follow-up (median, 173 months [range, 165–187 months]). During the preoperative and 14-year follow-up assessments, all participants from both groups underwent multiple subjective and objective tests including ROM, single-leg-hop test, Lysholm knee scoring scale, Knee injury and Osteoarthritis Outcome Score (KOOS), and Tegner activity scale. Knee laxity was evaluated using a KT-1000 arthrometer, the manual Lachman test, and the pivot-shift test. Standard radiographs with weight-bearing views were obtained early in the postoperative period (at about six weeks) and as part of the 14-year follow-up to assess the development of osteoarthritis. The images were interpreted and evaluated by a single independent experienced musculoskeletal radiologist using the Ahlbäck and Kellgren–Lawrence classification systems, and the Fairbank system.

**RESULTS:** Following the loss of 32 patients to the final follow-up and excluding patients who had undergone revision ACL ( $n = 5$ ) or TKA ( $n = 1$ ) of the index knee and one patient with contralateral femur fracture, 14-year follow-up was conducted on 64 patients between February 2023 and March 2024 (61% overall; SB:  $n = 29$  [56%]; DB:  $n = 35$  [66%]). No significant differences were found between the groups in terms of the pivot-shift and manual Lachman grades, KT-1000 arthrometer laxity measurements, single-leg-hop test, range of motion, Lysholm knee and Tegner activity scores, and Knee injury and Osteoarthritis Outcome Score (KOOS). Correspondingly, no differences were found between the groups regarding the presence of radiographic OA. Both groups showed significant improvement at follow-up compared with preoperative data in all objective and subjective outcomes ( $P < .05$ ).

## DISCUSSION AND CONCLUSION:

The present results reject the initial hypothesis that the anatomic DB technique would result in a lower incidence of positive pivot-shift test outcomes compared with the anatomic SB technique. Additionally, the study rejects the secondary hypothesis that the DB group would exhibit fewer radiographic findings of OA at long-term follow-up. Moreover, these findings are consistent with outcomes reported by other studies conducted within a comparable time frame.

## Conclusion:

At the 14-year follow-up, the anatomic DB technique displayed no superiority over the anatomic SB technique in terms of clinical outcomes or in the development of OA. Consequently, the anatomic SB technique may be considered the preferred method for ACL reconstruction.

